

## INTERESTING FACTS AND FIGURES

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### Did you know...

...that the 3.5-liter, methanol-powered engines of IRL IndyCar Series cars produce more than 675 horsepower, more than four times that of the average street car?

...that each of the eight pistons in an IRL IndyCar Series engine travels nearly 1 mile up and down in the cylinder every minute?

...that each of the eight pistons in an IRL IndyCar Series engine is subjected to a maximum acceleration of 70,000 times the force of gravity?

...that the fuel mileage of an IRL IndyCar Series car is less than two miles per gallon? A car burns approximately 1.3 gallons of fuel per lap at the Indianapolis Motor Speedway.

...that an IRL IndyCar Series car accelerates from 0 to 100 mph in less than three seconds, more than nine seconds quicker than it takes a production Porsche 911 Turbo street car to reach the same speed?

...that the 1,525-pound IRL IndyCar Series cars generate 5,000 pounds of downforce at 220 mph, enough to allow the car to run upside down if that speed is maintained?

...the tread depth of an IRL IndyCar Series tire is  $\frac{3}{32}$ nds of an inch – slightly thicker than a credit card?

...a front tire for the IRL IndyCar Series series weighs in at approximately 18 pounds - slightly less than the average weight of a 1-year-old child?

...at speed, the tread area of the racing tires approaches the temperature of boiling water (212 degrees Fahrenheit)? At those levels, the tread area actually becomes tar-like in consistency to help the tires and car adhere to the track.

...at any given moment on the racetrack, the total area of all four tires that is in contact with the track surface is equal to about 1 square foot? That means that an area not much bigger than a sheet of notebook paper is responsible for transferring all the technology and power generated by IRL IndyCar Series cars into speeds exceeding 220 mph.

...at speeds of 220 mph, the front tires of an IRL IndyCar Series car rotate at a rate of 43 times per second. That means, over the course of a single lap at Indianapolis Motor Speedway, the front tire will experience approximately 1,955 revolutions, and the rear tires will experience 1,800 revolutions. Considering a normal fuel stint is 30 laps or more at Indianapolis, each tire could experience more than 60,000 revolutions before it is changed for a fresh set.

...that the draft (or the “hole” in the air) created by an IRL IndyCar Series car extends 25 feet behind the car?

...that while traveling approximately 220 mph, IRL IndyCar Series cars travel slightly more than the length of a football field in about one second?

...IRL IndyCar Series drivers endure G-forces equal to nearly four times the weight of gravity while going through turns? The space shuttle leaves the launching pad at Cape Canaveral with approximately the same force.

**Sources:** Indy Racing League Public Relations, Indy Racing League Technical Department, IRL IndyCar Series race teams, Firestone, Chevrolet.

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## **RACING FLAG COLORS AND MEANINGS**

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| <b>Checkered Flag:</b>                              | Signifies the end of the practice session, qualification attempt or race. The race leader is declared the winner.                                      |
| <b>Green Flag:</b>                                  | Signals the start of the practice session, qualification attempt or race and all restarts after a caution or red-flag period.                          |
| <b>White Flag:</b>                                  | Displayed when the leader starts the final lap of the race. During qualifications, signals that driver has started final lap of qualification attempt. |
| <b>Royal Blue Flag with Diagonal Orange Stripe:</b> | The “passing flag,” signals slower cars to yield to faster traffic.  |

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| <b>Red Flag:</b>                    | Signals that the race stops immediately, regardless of position of cars on the track.   |
| <b>Black Flag:</b>                  | Directs a driver to proceed to the pits on the next lap and to follow the instructions of race officials.   |
| <b>Black Flag with White Cross:</b> | Officials have ceased scoring the car until further notice.   |
| <b>Yellow Flag:</b>                 | The “caution flag,” signals hazardous conditions on the track, and cars must slow immediately, maintain position and yield to track safety vehicles until the green flag is displayed. During a qualification session, a qualification attempt is halted. |

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## GLOSSARY OF INDY RACING TERMS

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**Adhesion** – The maintenance of contact between two touching objects. Adhesion refers to a static condition, whereas traction (also known as “grip”) refers to a moving condition.

**Aerodynamics** – As applied to racing, the study of the interaction between air and the resistance and pressures created by the passage of a moving car through the air.

**Apron** – The paved (and usually flat) portion of a racetrack that separates the racing surface from the infield. Generally, a concrete wall or steel guardrail separates the apron from the infield.

**Attenuator** – A safety device made of carbon fiber and honeycombed aluminum mounted on the rear of the gearbox. Enhances driver protection by absorbing much of the force of a rear impact.

**Bite** – Adhesion of a tire to the track surface.

**Blister** – Bubbles on the surface of a tire created by overheating of the tread compound.

**Camber** – Degree to which right-side tires lean in toward the car (from the top of the tire) and the left-side tires lean out. A useful tool to gain grip in corners by maximizing the amount of tire-to-track contact.

**Camshaft** – A rotating shaft in the engine that opens and closes the engine’s intake and exhaust valves.

**Chassis** – The central body of the car, including the driver’s compartment. Also referred to as the “tub.”

**Contact patch** – The portion of the tire that makes contact with the racing surface. Various chassis and tire adjustments can be made to maximize the contact patch.

**Crankshaft** – The rotating shaft within the engine that is turned by the up-and-down motion of the pistons. The crankshaft transfers power to the flywheel, and in turn to the transmission. The crankshaft is housed within the crankcase, which is part of the engine block.

**Diaper** – A blanket made from ballistic and absorbent material that surrounds part of the engine and serves as a containment device during accidents and engine malfunctions.

**Disc** – In brakes, the rotor, the part which revolves and against which brake linings are pressed during braking.

**Displacement** – In an engine, the total volume of air-fuel mixture an engine theoretically is capable of drawing into all cylinders during one operating cycle.

**Downforce** – Creation of force through aerodynamics, which keeps the car stuck to the track. High-speed movement of air underneath the car creates a vacuum, while the wings on the car force it to stay on the ground, acting in a manner opposite to the wings on a jet airplane.

**Drafting** – See “Tow.”

**Dyno** – Short for “dynamometer,” a static machine used to measure an engine’s horsepower output.

**Engine block** – An iron casting from the manufacturer that contains the crankshaft, connecting rods and pistons.

**Fuel injection** -- A system replacing conventional carburetion that delivers fuel under pressure into the combustion chamber of the engine or airflow before entering the chamber.

**Grip** – How well the tires maintain traction through contact with the racing surface.

**Groove/line** – Term for the fastest or most efficient way around the racetrack. Often most drivers will use the same groove around the racetrack, and that portion of the track will consequently appear darker in color than the rest of the track due to the buildup of tire rubber.

**Handling** – A race car’s on-track performance, determined by factors such as tire and suspension setup, and other aerodynamic issues.

**Line** – See “Groove.”

**Loose** – The rear of the car is unstable due to a lack of rear-tire grip caused by too much front downforce or not enough rear downforce. Also known as “oversteer.”

**Marbles** – Excess rubber buildup above the groove on the track, the result of normal tire wear throughout the race.

**Methanol** – Technically pure methyl alcohol produced by synthesis that is used as fuel in all IRL IndyCar Series cars.

**Neutral** – Term used to describe the handling of the car when it is neither loose nor pushing (tight).

**Nomex** – Trade name of DuPont, a fire-resistant fabric used in the manufacturing of protective clothing.

**Pushing** – The car does not want to turn in the corners due to a lack of tire grip. This can be caused by a lack of downforce on the front of the car or too much downforce on the rear of the car. Also known as “understeer” and “tight.”

**Rev limiter** – Electronic/computer device in the engine controls that causes a controlled engine misfire if engine revolutions per minute (rpm) exceed the limit set by Indy Racing League rules. The legal rpm (or “rev”) limit for 2003

is 10,300 rpm. The rev limiter is used primarily to control speeds, thereby increasing safety and controlling costs.

**Ride height** – The distance from the bottom of the chassis to the ground when a car is at speed. Indy Racing League rules stipulate that the ride height of the sides of a car should be 2 inches off the ground for all tracks.

**RPM** – Abbreviation for revolutions per minute.

**SAFER Barrier** – The Steel and Foam Energy Reduction (SAFER) Barrier, an energy-absorbing barrier system attached to the outside retaining walls in each of the four turns of the Indianapolis Motor Speedway. The new energy-absorbing barrier, installed in May 2002, is constructed in 20-foot modules. Each module consists of four rectangular steel tubes, welded together, to form a unified element. The modules are connected with four internal steel splices. Bundles of 2-inch-thick sheets of extruded, closed-cell polystyrene are placed between the concrete wall and the steel tubing modules every 10 feet. Six or seven sheets of polystyrene are used in each bundle, depending on the location on the module.

**Short track** – Racetracks that are 1 mile or less in length.

**Side pod** – Bodywork on the side of the car covering the radiators and engine exhaust. Aids in engine cooling, car aerodynamics and driver protection in the event of a side impact.

**Slick** – A track condition where a car's tires do not adhere to the surface. This could be for a variety of reasons, such as a lack of rubber on the surface (a "green track"), dirt on the track or high track temperatures.

**Stagger** – Right-front and/or right-rear tire is larger in diameter than left-side tires in order to improve turning ability on ovals.

**Sticker tires** – Slang term for new tires, derived from the manufacturer stickers placed on each brand-new tire.

**Superspeedway** – A racetrack of more than 1 mile in length.

**Suspension & Wheel Energy Management System (SWEMS)** – Wheel-restraint system using multiple restraints attached at multiple points to a car's chassis and suspension designed to minimize the possibilities of wheel assemblies becoming detached during high-speed accidents. The restraints

are made of FIA-approved Zylon. This material, with its high-tensile properties and its wound construction (opposed to woven), has a breaking strength of 5 tons. The Indy Racing League introduced SWEMS in May 1999.

**Telemetry** – A radio device that relays information such as engine, tire, steering and throttle performance to team engineers in the pits. The team can monitor both car and driver activity to ensure the car is performing properly. Also enhances driver safety by allowing the team to notice any developing mechanical problem the driver cannot foresee.

**Tight** – Also known as “understeer.” A handling condition characterized by a lack of grip in the front tires. As the driver steers through a turn, the front wheels want to continue straight ahead.

**Tire compound** – A formula based on rubber polymers, oils, carbon blacks and curatives used to create a tire. The varying lengths and banking of IRL IndyCar Series tracks require different compounds.

**Tow/drafting** – As a car moves around the track at 220 mph, it literally splits the air, some of which goes over the car, and some of which goes beneath. This lack of air behind the car creates a vacuum, which a trailing car may use to be pulled, or “towed,” by the lead car.

**Tub** – See “Chassis.”

**Weight jacker** – A hydraulic cylinder the driver uses to adjust car handling from the car’s cockpit while racing. The cylinder compresses or extends springs, which transfers the car’s weight distribution from one side of the car to the other, thereby adjusting the car’s handling to the driver’s liking.

**Wicker bill** – A long, narrow, removable spoiler made of steel, aluminum or carbon fiber on the trailing edge of the front and rear wings which varies in height, creating downforce. Teams will use different sized wicker bills to create more or less downforce. The larger (higher) the wicker bill, the greater the downforce, and vice versa for smaller wicker bills.